[2345/157]

DEVICE FOR CONTROLLING A TELECOMMUNICATIONS SYSTEM

The present invention is directed to a device for controlling a telecommunications system made up of a plurality of networks, the networks being designed for services or parts of services, a network management device being assigned to each network, and the network management devices being controllable by service management devices.

In the broadest sense, telecommunications systems are made up of a plurality of networks, several of which are interconnected, depending on the particular requirement, to establish an end-to-end connection. To control and monitor such systems, a functional management architecture is required, as described, for example, in ITU-T recommendations, in particular M.3010. A management architecture of this kind is schematically illustrated in Figure 2.

The lowest layer contains network elements NE, which are each managed by an element management device EMS. Above that, resides a layer made up of network management devices NMS, to which service management devices SMS are linked at a higher level. The functions of service management device SMS can be assumed, in part, by the customers themselves. This function is referred to as customer network management CNM. To manage the entire communications system in terms of business operations, the business management device BMS is then used.

In a nutshell, the network management devices are responsible for monitoring and controlling the network elements situated in one geographic region, while the

contractual aspects of the services provided to the customers are the focus of the service management devices (these include, inter alia, service orders, service complaints, and billing/accounting). In this connection, the concepts "NMF = network management function" and "SMF = service management function" were introduced for the functionalities allocated to the respective management layers.

An important capability of the communications system is to make available so-called end-to-end connections, a plurality of networks being required depending on the type of connection. To provide this as a most versatile possible service, the service management devices must, therefore, access a multiplicity of network management devices NMS. The result in the known systems is, therefore, a so-called many-to-many relation, as illustrated in Figure 3. In the process, the number of interfaces required between the network management devices NMS and the service management devices SMS quickly becomes virtually unmanageable.

The object of the present invention is to provide a device for controlling a telecommunications system made up of a plurality of networks, which, without entailing the mentioned disadvantages, will enable the service management devices to access the network management devices required for the particular services.

This objective is achieved in accordance with the present invention by providing domain management devices, which enable the service management devices to access network management devices. The domain management devices, in turn, have access to selected network management devices and are each able to be linked to a service management device.

The device according to the present invention requires a substantially smaller number of interfaces at the service management devices and the network management devices than do known devices.

One advantageous embodiment of the device according to the present invention provides for a controllable matrix for linking the service management devices to the domain management devices. It is preferably provided, in this context, for the controllable matrix to be controlled in conformance with the end-to-end connections to be managed in each instance.

A further refinement of the device according to the present invention provides for at least one customer network management device to be connectable via the matrix. This renders possible a dynamic allocation between the particular network management devices and customer network management devices, without entailing additional outlay for switching equipment.

Exemplary embodiments of the present invention are represented by several figures in the drawing and are elucidated in the following description. The figures show:

Figure 1 a block diagram of an exemplary embodiment;
Figure 2 a schematic representation of the known multilayer concept in accordance with the ITU-T recommendation;
Figure 3 a schematic representation of the many-to-many relations between service management devices and network management devices;
Figure 4 a block diagram of a further exemplary embodiment;
Figure 5 a block diagram of a domain management device employed in the device according to Figure 4;

Figure 6 an example of an end-to-end connection traversing a plurality of networks which are managed by a device in accordance with the present invention; and

Figures 7 through 9 tables for illustrating the improvements effected by the present invention.

Figure 1 illustrates three service management devices SMS, each of which is connected to three domain managers DM, to which three or two network management devices are connected, in turn. A comparison to Figure 3 reveals that substantially fewer interfaces are needed than is the case when working with the known device.

In the exemplary embodiment in accordance with Figure 4, five service management devices 1 through 5 are able to be connected via a matrix 6, in the following, also referred to as correlation matrix, to five domain managers 7 through 11. Domain managers 7 through 11 have access to network management devices, of which merely three network management devices 12, 13, 14, are shown as examples in Figure 4.

Also connected to correlation matrix 6 is a server 15 for the customer network management. Moreover, correlation matrix 6 is connected to two databases 16, 17, one being used as database KD DB (customer database), and the other as database SLA (= service level agreement). Server 15 can exchange data via two layers 18, 19 with customer devices 20, layer 18 providing a suitable operational structure in the sense of a corporate identity, identifying the telecommunications carrier, while layer 19 is designed as a security layer. In addition, each of network management devices 12, 13, 14 has assigned B-CNM (= basic customer network management) devices, whose data are fed to server 15.

For further clarification of the exemplary embodiment in accordance with Figure 4, reference is first made to Figures 4 and 5. Figure 5 depicts the functional units of a domain manager 7 through 11 (Figure 4). In this context, a management information distributor 31 is employed for the connection to correlation matrix 6 (Figure 4). A further data processing device 32 is used for data preparation, for precorrelation, and for converting from NMF to SMF. Subsystem adapters 33, 34, 35, of which merely three are shown illustratively in Figure 5, are used for the connection to the particular network management devices.

In parallel to service management devices 1 through 5, the service-oriented information is supplied to customer network management server 15. This ensures a uniform, comprehensive method for accessing the CNM information. The customer databases, domain-, service-, and customer-network management devices are linked with the aid of correlation matrix 6, employing an object-based communications infrastructure, which supports an end-to-end service correlation and renders possible a flexible modeling of complex services by combining the information communicated by the domain managers.

This communications infrastructure enables the service-relevant interconnection objects of various domain managers to be queried by the responsible service management device SMS, and for status modifications to be routed by the domain managers in dedicated fashion to service management device SMS. In addition, it provides the basis for transmitting customer queries from the customer network management system to service management device SMS and vice versa, to make available information of relevance to the customer, from service management device SMS via the customer network management system. Also the basic information for the correlation is fed via

this communications infrastructure to the domain managers, service management devices SMS, and to the customer network management systems.

The functionality of the domain managers resides in the adaptation of the subsystems, in the conversion of the network management information received from the subsystems, from the domains of fault, performance, and configuration management, into service-oriented information, as well as in the conversion of requests received from the service management devices into network management requests, and in the routing of such requests to the appropriate network management devices. The interface directed to service management devices is designed as a standardized, object-oriented interface, and is integrated in the communications infrastructure. Moreover, the domain manager assures the bidirectional exchange of information, and that the requests contained in the security concept with respect to access restrictions to the network management devices and with respect to the integrity and confidentiality of the data are observed (security management functions).

Figure 6 depicts the networks and management devices used for a frame-relay end-to-end connection. The connection is established between two terminal devices 41, 42, shown as computers, in each case via a customer service switch 43, 44, access networks 45, 46, and an ATM network 47 as a backbone network. A network management device 48, 49, 50 is provided to manage each of these networks. Each of these network management devices is assigned, together with other network management devices, to a domain manager 51, 52. A service management device 53 has access to domain managers 51, 52 via a correlation matrix that is not shown in Figure 6. For purposes of exchanging data, customer database 16 is linked to the domain managers and to service management device 53. Moreover,

customer network management device 54 is connected to the service management device. The end-to-end connection from point A to point B is displayed on a screen 55 of customer network management device 54, making it possible for an operator to visualize the status of the connection and to intervene in case of errors.

The benefits of the device according to the present invention are elucidated in the following on the basis of an application example, where service and customer network management are made available for services based on ATM, frame relay, and leased link. For this, network management information from the following networks is to be integrated:

- 3 NMS for access components (B-NT-NMS, DTNMS and router NMS);
- 2 NMS for leased link (BFS, 46020);
- 3 NMS for ATM (Nortel NMS, 46020, NavisCore);
- 1 NMS for frame relay (Nortel NMS).

The relevance of the management information from the management perspective can be inferred from Figure 7.

From this it is apparent that, on the average, two interfaces are required per network management device in the direction of the service management devices; and five to seven interfaces per service management device in the direction of the network management devices.

Figure 8 depicts the interfaces required at the domain managers in the direction of the individual networks and vice versa; while Figure 9 illustrates the interfaces required between the domain managers and the service management devices. One can discern that, regardless of the number of service management devices and independently of the service modeling, only one interface is needed for each network management device. The

advantages are particularly evident by the reduction in the load on the network management devices and the networks resulting from the transfer of management information. Also, the number of subnetwork management devices to be integrated per domain is substantially less than the number needed for a direct integration.

The correlation matrix can be used to properly channel the information relevant to the individual service management devices by performing a one-time correlation to administrative customer data. Customer network management server 15 is interfaced in such a way that all information relevant to customer network management is acquired via the correlation matrix as service-spanning information, but is provided with customer and service identification.